



Review of the little-known western Nearctic fly genus *Philetus* Melander (Diptera: Empididae), with a discussion of its phylogenetic assignment

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Abstract

The western North American empidid genus *Philetus* Melander is reviewed, including redescription of the two included species, *P. memorandum* Melander and *P. schizophorus* Melander. A lectotype is designated for *P. schizophorus*. The distributions of both species are mapped and the male terminalia are illustrated. The female of *P. schizophorus* is discovered for the first time through comparison of COI mitochondrial DNA barcode sequences. The phylogenetic assignment of *Philetus* within the Empididae is discussed based on a reinterpretation of male terminalia homologies.

Key words: Diptera, Empididae, *Philetus*, *Hesperempis*, dance flies, systematics, western North America, male terminalia, phylogeny, DNA barcodes

Introduction

The Nearctic genus *Philetus* Melander (1928) is a poorly-known group of empidid flies established for two rarely collected western species. Melander (1928) originally placed *Philetus* in the subfamily Empidinae, but Sinclair & Cumming (2006) classified the genus as *incertae sedis* within the family Empididae. Both species, namely *P. memorandum* Melander and *P. schizophorus* Melander, are sporadically taken and are seldom found in collections. Little has been published since Melander's original description and simple illustrations in 1928, although Sinclair & Cumming (2006) included *P. memorandum* as an exemplar species in their reclassification of the Empidoidea, illustrating some diagnostic features of that species, including the antenna, mouthparts, wing, and male and female terminalia.

This review updates the descriptions and collection data for both species, and illustrates the male terminalia of both species. A discussion of the phylogenetic placement of *Philetus* within the Empididae is also included. This paper provides a more complete profile of this poorly-known genus, aiding in detection and identification of additional congeneric specimens. Hopefully this will lead to further discoveries that will ultimately assist in properly classifying this enigmatic group.

Material and methods

This study is based on specimens borrowed or deposited in the following collections: California Academy of Sciences, San Francisco, USA (CAS); Canadian National Collection of Insects, Ottawa, Canada (CNC); California State Collection of Arthropods, Sacramento, USA (CSCA); University of Guelph Insect Collection, Guelph, Canada (DEBU); Iowa State Insect Collection, Ames, USA (ISIC); Royal British Columbia Museum, Victoria, Canada (RBCM); Spencer Entomological Museum, University of British Columbia, Vancouver, Canada (UBCZ);

United States National Museum of Natural History, Washington D.C., USA (USNM); W.J. Turner Collection, Washington State University, Pullman, Washington, USA (WJTC); M.T. James Museum, Washington State University, Pullman, USA (WSU).

Female specimens collected from the same localities as males at or around the same seasonal date, were generally assumed to be conspecific with males. A number of female specimens of *P. memorandum* were associated in this way, but no male and female specimens of *P. schizophorus* were collected together. To provide additional evidence for species identity, several specimens of *Philetus* were submitted for barcoding to the Biodiversity Institute of Ontario in Guelph, ON, Canada. A single leg was removed from each specimen to obtain mitochondrial DNA barcodes (658 base pairs from the 5' end of COI). The DNA was extracted, amplified, purified and sequenced following the protocols given by Hajibabaei *et al.* (2005). Successful COI sequences were deposited in GenBank (Table 1). COI sequences of >450 base pairs (bp) were analyzed with a Neighbour-joining tree (Fig. 24) created in the Barcode of Life Data Systems (BOLD) using the BOLD Aligner (Amino Acid based HMM) (Ratnasingham & Hebert 2007). Species identities were confirmed by comparing COI sequences from males and females that clustered together with <2% genetic divergence (Hebert *et al.* 2003). Additional female specimens of uncertain identity are listed in the Appendix, with their localities included in the distribution map of the genus (Fig. 21).

TABLE 1. Voucher information for *Philetus* and outgroup specimens submitted for barcoding, including geographic locality, institution housing the specimen (in parentheses), sequence length in base pairs, unique voucher number, and GenBank number.

Species, sex	Locality	Sequence length	Voucher	GenBank
<i>Chelipoda elongata</i> ♂	Canada: QC: nr. Squatec (CNC)	467bp	CNC DIPTERA #161781	KU565799
<i>Hesempis mabelae</i> ♂	USA: ID: Latah Co. (CNC)	658bp	CNC DIPTERA #163450	KU565794
<i>Oreogeton scopifer</i> ♂	USA: CA: Placer Co. (CNC)	658bp	CNC DIPTERA #192127	KU565801
<i>Philetus memorandum</i> ♀	Canada: BC: Vancouver Is., (CNC)	307bp	CNC DIPTERA #103891	KU565803
<i>Philetus memorandum</i> ♀	Canada: BC: Vancouver Is. (CNC)	307bp	CNC DIPTERA #103888	KU565800
<i>Philetus memorandum</i> ♂	Canada: BC: Vancouver Is. (CNC)	294bp	CNC DIPTERA #103886	KU565797
<i>Philetus memorandum</i> ♀	Canada: BC: Vancouver Is. (CNC)	264bp	CNC DIPTERA #103890	KU565796
<i>Philetus memorandum</i> ♀	USA: OR: Benton Co. (CNC)	658bp	JSS #43838	KU565791
<i>Philetus memorandum</i> ♂	USA: CA: Del Norte Co. (CNC)	658bp	CNC DIPTERA #103882	KU565802
<i>Philetus memorandum</i> ♂	USA: CA: Del Norte Co. (CNC)	658bp	CNC DIPTERA #103883	KU565788
<i>Philetus memorandum</i> ♀	USA: CA: Del Norte Co. (CNC)	658bp	CNC DIPTERA #103884	KU565785
<i>Philetus memorandum</i> ♀	USA: CA: Del Norte Co. (CNC)	342bp	CNC DIPTERA #103895	KU565798
<i>Philetus memorandum</i> ♀	USA: CA: Del Norte Co. (CNC)	326bp	CNC DIPTERA #103892	KU565795
<i>Philetus memorandum</i> ♀	USA: CA: Del Norte Co. (CNC)	307bp	CNC DIPTERA #103893	KU565792
<i>Philetus memorandum</i> ♀	USA: CA: Del Norte Co. (CNC)	307bp	CNC DIPTERA #103896	KU565790
<i>Philetus memorandum</i> ♀	USA: CA: Humboldt Co. (CNC)	657bp	CNC DIPTERA #103885	KU565787
<i>Philetus memorandum</i> ♀	USA: CA: Humboldt Co. (CNC)	307bp	CNC DIPTERA #103887	KU565589
<i>Philetus schizophorus</i> ♀	Canada: BC: Glacier NP (CNC)	658bp	JSS #43836	KU565786
<i>Philetus schizophorus</i> ♂	USA: CO: Larimer Co. (CNC)	658bp	JSS #43839	KU565804

Terms used for adult structures primarily follow those of Cumming & Wood (2009), except for wing venation where the terms of Saigusa (2006) are used (Fig. 9). In the system outlined by Saigusa (2006), the dipteran wing vein A₁ (as used in McAlpine 1981) is homologized with the Mecoptera vein CuP, CuA₁ (of McAlpine) is

considered M_4 , whereas CuA_2 is interpreted as CuA , and the posterior cubital cell (cup) is believed to be cell cua .

Male and female terminalia were macerated in 85% lactic acid heated in a microwave oven. Each microwave heating interval comprised 15–30 seconds and was followed by a 1–2 minute cooling period during which macerated muscle tissue was removed with a fine probe. Terminalia were subsequently examined in glycerin on a depression slide.

Label data for primary types are cited from the top downward, with the data from each label in quotation marks. Labels are cited in full, with original spelling, punctuation, and date, and label lines are delimited by a slash (/). Additional information is included in square [] brackets. The repository of each type is given in parentheses. Secondary type data are abridged and listed alphabetically.

Genus *Philetus* Melander

Philetus Melander, 1928: 110. Type species, *Philetus memorandum* Melander, 1928 (original designation). Melander, 1965: 455; Poole, 1996: 158, 368; Sinclair & Cumming, 2006: 74, 102–105, 107; Yang *et al.*, 2007: 350; Marshall, 2012: 288; Cumming *et al.*, 2014: 171, 205.

Diagnosis. The genus is characterized by the following features: small size (body length 3.0–5.0 mm) brownish grey flies with silvery grey tomentum (Figs 1, 4); head produced obliquely downwards; ocelli positioned forward on broad V-shaped frons; eyes bare, dichoptic in male and female; inner eye incision present; antenna inserted just below middle of eye (Figs 5, 6); apical stylus slightly tapered with 3 articles including minute terminal hyaline process, subequal to or slightly shorter than length of pyriform postpedicel (Figs 7, 8); proboscis moderately long; epipharyngeal blades movable; palpus straight, directed forward (Figs 5, 6); head and thoracic chaetotaxy dark; mesonotal setae on each side with a few short irregular presutural acrostichal setae, row of 4–6 long dorsocentral and 3–4 intra-alar setae, 1–2 postpronotal setae, 1–2 presutural supra-alar setae, 2 notopleural setae, 1 postalar seta, and 2 (pairs) of long scutellar setae; mesopleuron and laterotergite bare; legs without prominent bristles; wing (Fig. 9) with venation complete (for *Eremoneura*), including nearly straight Sc reaching C , forked R_{4+5} , cell cua angled apically with CuA curved back towards short evanescent $CuA+CuP$ vein, basal costal bristle present, pterostigma faint, anal lobe developed; male terminalia (Figs 11–20) with median apical hypandrial process, gonocoxal apodeme projecting anteriorly as process from anterodorsal margin of hypandrium, postgonite broad, ejaculatory apodeme lever-like and articulated to base of phallus, phallus tubular with desclerotized apex, epandrium deeply emarginate with left and right lamella connected basally, epandrial lobe present apically, proctiger differentiated into a long ventral and short medial subepandrial lobe attached to prolonged dorsal cercus; female terminalia (Fig. 10) with terminal segments partially telescopic, tergite 10 undivided without acanthophorites, cercus narrow, spermatheca unpigmented and sac-like.

Geographical distribution (Fig. 21). Known from Alaska and the Yukon Territory in the north to California, Nevada and Arizona in the south, including records from British Columbia, Washington, Oregon, Montana, Wyoming and Colorado (with undetermined female specimens listed in the Appendix).

Remarks. In the Nearctic Region, this genus is most similar to *Hesperempis* Melander and somewhat like *Hilara* Meigen, but can be most easily distinguished from these empidid genera by the oblique form of the head with forward positioned ocelli and low inserted antennae. *Philetus* also has straight forward-directed palps and vein Sc nearly straight and joining C at an acute angle unlike *Hilara*. In addition, *Hilara* and most members of the Hilarini have vein R_1 swollen prior to reaching C and males usually have the first tarsomere of the foreleg expanded (Sinclair & Cumming 2006). In their key to Nearctic genera of Empididae, Steyskal & Knutson (1981, p. 617) refer to a complete lack of thoracic setae in *Hesperempis* compared with *Philetus*, but this does not apply to all the included species of *Hesperempis* (Cumming *et al.* 2014). However, the dark setae on the head and thorax of *Philetus* are diagnostic compared with the pale more inconspicuous chaetotaxy of *Hesperempis*.

Except for differences in the male and female terminalia, specimens of *Philetus* also resemble the brachystomatid genus *Heleodromia* Haliday, although they can be easily separated by the presence of a forked R_{4+5} wing vein in *Philetus*. Marshall (2012: 288, fig. 5) provided a good-quality photograph of a live female specimen of *Philetus*, which is reproduced here with permission (Fig. 1).



FIGURES 1–3. *Philetus* habitus photograph and habitat. **1.** *Philetus* sp., live female; photograph by S.A. Marshall. **2.** Sitka spruce canopy, Upper Carmanah Valley, Vancouver Island, British Columbia. **3.** Coastal wet temperate rainforest, Upper Carmanah Valley.

***Philetus memorandum* Melander**

(Figs 4, 7, 9–11, 13–16, 22)

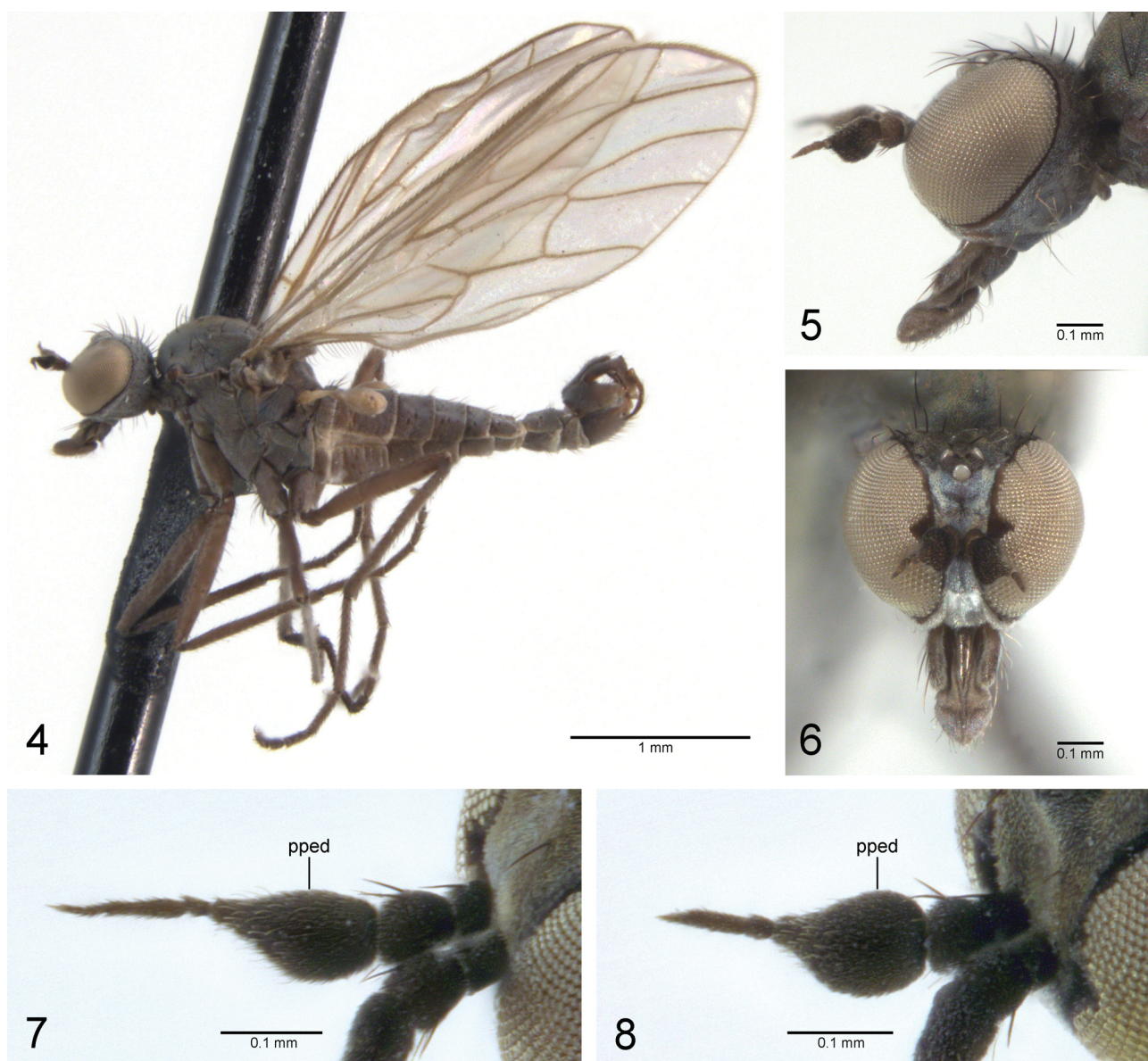
Philetus memorandum Melander, 1928: 110. Melander, 1965: 455; Poole, 1996: 158, 508; Sinclair & Cumming, 2006: 74, 98, 102–105, 107, 111, 117, 126, 139, 150, 166; Yang *et al.*, 2007: 350; Cumming *et al.*, 2014: 172, 210.

Type material examined. HOLOTYPE, ♂ labelled: “MtConstitution/ 22 Jul Wash”; “TYPE/ *Philetus*/

memorandus/ Mel. [mostly hand-written red label]"; "ALMelander/ Collection/ 1961" [specimen off minuten mount, glued to mostly hand-written red type label; missing mid legs (except coxae), right hind leg (except coxa) and left hind tarsus] (USNM). **PARATYPES. USA. Washington:** Mt. Rainier, Longmire, 18.vii.1922, A.L. Melander (1♂, USNM); Mt. Rainier, Narada Falls, 16.viii.1917, A.L. Melander (1♀, USNM); Mt. Rainier, Van Trump [Creek], 21.vii.1922, A.L. Melander (1♂, 1♀, USNM). **Wyoming:** Yellowst[one] Park, Canyon Camp, 12.viii.1918 [misidentified, conspecific with *P. schizophorus*] (1♀, USNM).

Additional material examined. CANADA. British Columbia: Haida Gwaii, Louise Is., Skedans [ca. 52°57'57"N 131°36'59"W], 3.vii.1981, G.G.E. Scudder (1♂, UBCZ); Haida Gwaii, Laskeek Bay, Haswell Is., 10.vii.2001, 52°51'46"N 131°41'17"W, Allombert, Sylvain, HI-1SWE-1, Royal British Columbia Museum ENT001–006098 (1♂, RBCM); Mount Thornhill [ca. 54°30'42"N 128°27'12"W] nr. Terrace, 26.vii.1960, B. Heming (1♀, CNC); same data except, 3000–4000 ft., C.H. Mann (1♀, CNC); same data except, 14.vii.1960, J.G. Chillcott, second growth hemlock forest (1♀, CNC); Vancouver Is., Sproat Lake [ca. 49°16'23.61"N 125°2'30.89"W], 22.vi.1955, G.E. Shewell (1♂, CNC); Vancouver Is., Upper Carmanah Valley, 48°44'N 124°37'W, 21.vi.–3.vii.1991, T1, 32 m, N. Winchester, MT, UTM 10U, CJ 801991 (5♂, 4♀, CNC); same data except, CNC DIPTERA #103890 (1♀ barcode-associated, CNC); same data except, CNC DIPTERA #103891 (1♀ barcode-associated, CNC); same data except, T2, 32 m (10♂, 3♀ CNC); same data except, T3, 39 m (15♂, 10♀, 1♀, CNC); same data except, CNC DIPTERA #103889 (1♀, CNC); same data except, CNC DIPTERA #103888 (1♀ barcode-associated, CNC); same data except, T4, 33m (3♂, 1♀, CNC); same data except, 4–15.vii.1991, T1, 32 m (1♀, CNC); same data except, 16–30.vii.1991 (1♂, CNC); same data except, T2, 32 m (1♂, CNC); same data except, T2, 32 m, CNC DIPTERA #103886 (1♂ barcoded, CNC); same data except, 31.vii.–11.viii.1991, T4, 33 m (1♂, CNC). **USA. California:** Del Norte County: ca. 6.5 mi. NE Gasquet, nr. Cold Spring Mountain, 41°52'15"N 123°53'21"W, 31.V.2009, S.E. Brooks (1♂, CNC); Jedediah Smith Redwoods SP, Walker Rd., ca. 41°48'44"N 124°6'36"W, 25.V.2009, creek, S.E. Brooks, CNC DIPTERA #103883 (1♂ barcoded, CNC); same data except, J.M. Cumming, CNC DIPTERA #103884 (1♀ barcode-associated, CNC); same data except, 22.v.–3.vi.2009, Malaise trap, J.M. Cumming & S.E. Brooks, CNC DIPTERA #103882 (1♂ barcoded, CSCA); same data except, CNC DIPTERA #'s 103892, 103893, 103895, 103896 (4♀ barcode-associated, CNC, CSCA); West Fork of Patrick Crk, 41°55'03"N 123°51'28"W, 31.V.2009, J.M. Cumming (1♂, CNC); same data except, 24–31.v.2009, Malaise trap, J.M. Cumming & S.E. Brooks (2♂, 3♀, CNC); Humboldt County: ca. 7 miles SE Orick, Lost Man Creek trail, 41°15'53"N 123°59'16"W, 2.vi.2009, J.M. Cumming (1♂, CNC); same data except, J.M. Cumming, CNC DIPTERA #103887 (1♀ barcode-associated, CNC); same data except, S.E. Brooks, CNC DIPTERA #103885 (1♀ barcode-associated, CNC). **Oregon:** Benton County: 5 mi. up Woods Crk Rd from jct. Hwy 20, riparian woods on creek edge, 30.v.–24.vi.2014, ca. 44.544022, -123.503047, MT014, S. Fitzgerald, JSS #43838 (1♀, barcode-associated, CNC); same data except, 6.4 mi. up Woods Crk Rd, across old road fir/alder/maple, 24.vi.–14.vii.2014, MT018 (1♀, CNC); Mary's Peak, upper Parker Creek, nr. cmpgrd, 44.5087°N 123.5583°W, 6.vi.–4.vii.2014, along creek, S. Fitzgerald (2♂, 1♀, CNC); Curry County: Siskiyou National Forest, nr. Elko Cmpgrd, 2500 ft., 42°23'07"N 124°13'44"W, 2.vi.2009, G. Courtney (2♂, 1♀, CNC; 2♂, ISIC); Lane County: Siuslaw Nat. For., 3 mi. S Yachats [ca. 44°16'N 124°6'W], 15.vii.1989, streams along Gwynn Crk Trail, B.J. Sinclair (1♂, CNC). **Washington:** Pacific County: Ft. Canby SP [ca. 46°16'N 124°04'W], nr. Ilwaco, 13–15.vi.1973, W.J. Turner (1♂, WJTC); Ilwaco [ca. 46°16'N 124°04'W], 12.vii.1922, A.L. Melander (1♀, USNM); Pierce County: Mt. Rainier NP, Comet Falls trail, 46°46.724'N 121°47.029'W, 16.vii.2012, 1090–1360 m, B.J. Sinclair (1♂, CNC); same data except, 46°47.499'N 121°46.930'W, 3.vii.2013, 1200–1450 m (4♂, 2♀, CNC); Longmire [ca. 46°44'59"N 121°48'45"W], 27.vi.1935, A.L. Melander (1♂, USNM); same data except, 20.vii.1922 (1♀, USNM); Narada Falls to Cougar Rock, 46°46.313'N 121°44.949'W, 6.vii.2013, B.J. Sinclair (1♂, CNC); Narada Falls to Reflection Lk. trail, 46°46'N 121°44'W, 1400 m, 17.vii.2012, B.J. Sinclair (1♀, CNC); Reflection Lk. to Narada Falls, 46°46.162'N 121°44.320'W, 17.vii.2012, snow patches, B.J. Sinclair (4♂, 1♀, CNC); Van Trump Crk, above Christine Falls [ca. 46°46'51"N 121°46'47"W], 3900 ft., 11.viii.1977, W.J. Turner (1♀, WJTC).

Diagnosis. *Philetus memorandus* is characterized by male terminalia (Figs 11, 13–16) with elongate cercus connected to wide medial subepandrial lobe and lengthened ventral subepandrial lobe with broad deflexed apex, large epandrial lobe with dorsal process and rounded apex, hypandrium with long hook-shaped apical rods above dorsally prolonged median apical process, postgonite projected dorsally as wide rounded lobe, and tubular phallus with partially desclerotized broadly expanded apex. The longer, more narrowly produced apex of the antennal postpedicel (Fig. 7) in both sexes separates most specimens from those of *P. schizophorus*.

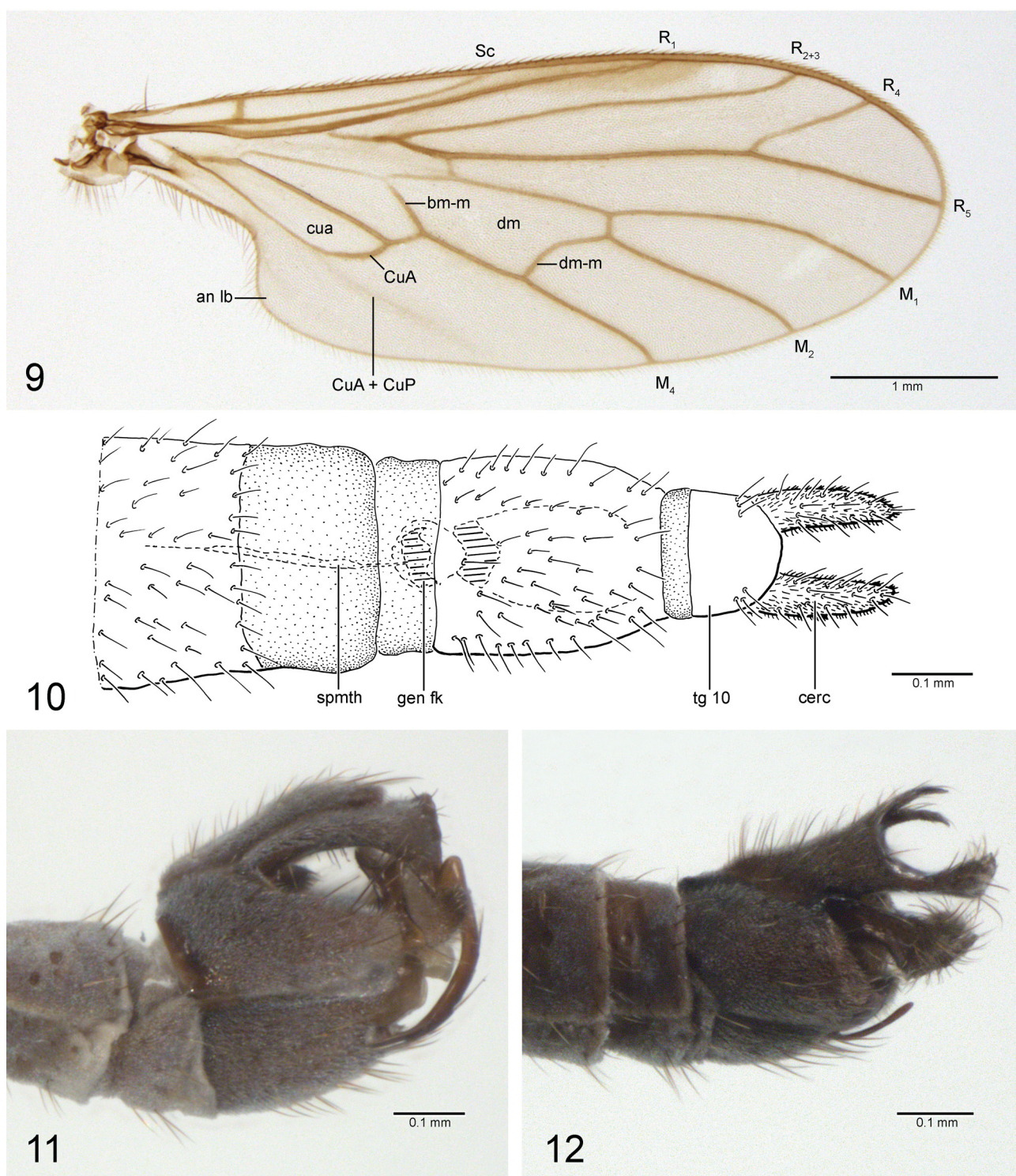


FIGURES 4–8. *Philetus* morphology. 4. *P. memorandus*, pinned male. 5. *P. schizophorus*, male head, lateral view. 6. *P. schizophorus*, male head, anterior view. 7. *P. memorandus*, female antenna. 8. *P. schizophorus*, female antenna. Abbreviation: pped—postpedicel.

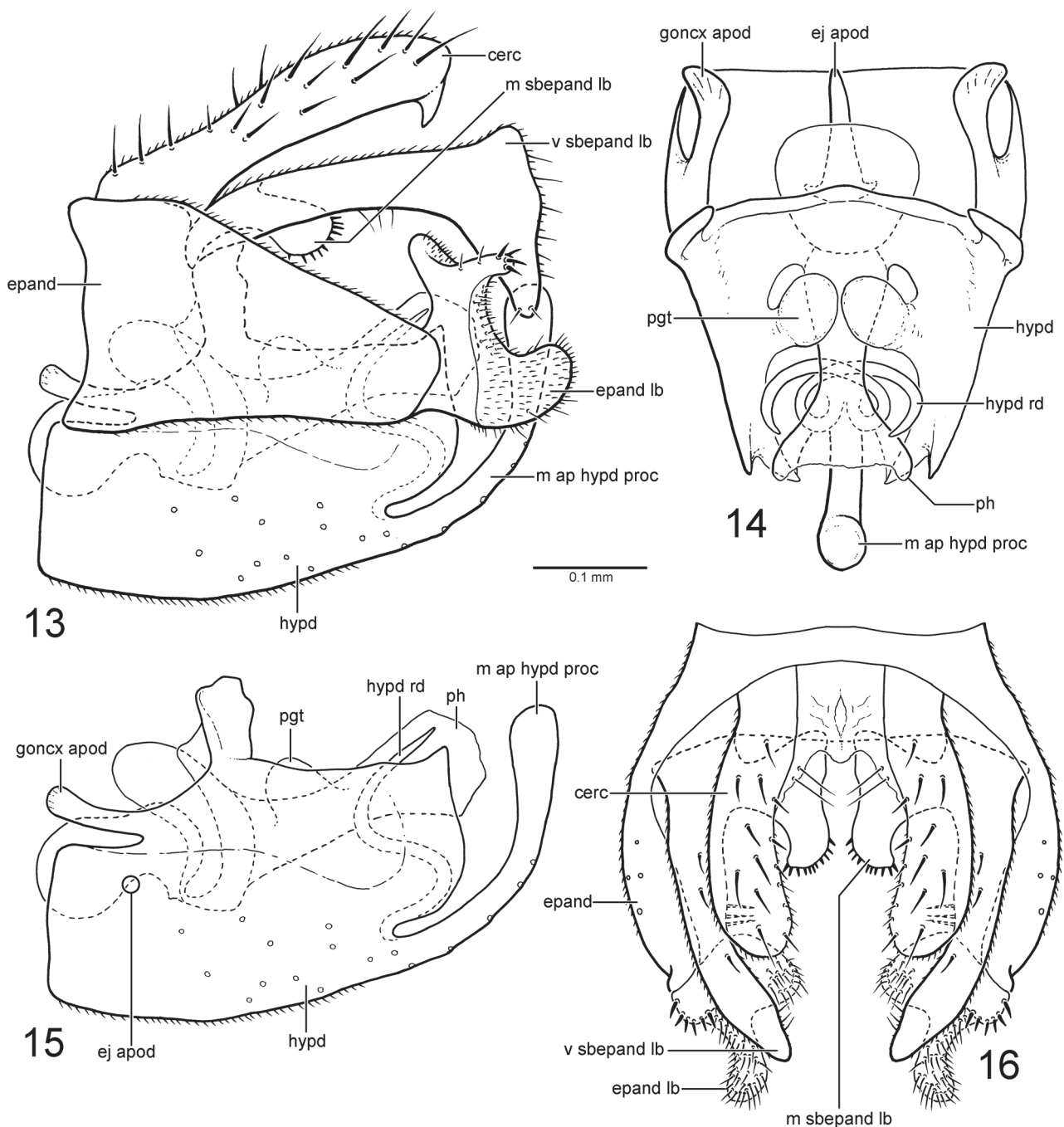
Redescription. Male. Body length 3.0–4.5 mm, dark brownish grey, covered with silvery grey tomentum. Antenna dark brown to black; postpedicel pyriform with apex narrowly produced towards stylus (Fig. 7). Legs brown to greyish brown. Wing hyaline with brownish veins. Halter brownish white. Terminalia (Figs 11, 13–16): hypandrium with long hook-shaped apical rods arising above base of long dorsally directed median apical process; postgonite projected dorsally as wide rounded lobe; phallus tubular, apex partially desclerotized and broadly expanded; epandrial lobe large with bifid dorsal process and rounded apex, apical surface covered with minute setulae; ventral subepandrial lobe lengthened with broad deflexed apex; medial subepandrial lobe wide, connected basally to both ventral subepandrial lobe and cercus, with short spine-like setulae along apical margin; cercus elongate, rounded apically with pronounced ventral hook.

Female. Body length 3.5–5.0 mm. Similar to male. Female terminalia (Fig. 10) partially telescopic; tergite 10 short; cercus approximately 3X as long as wide. Nearly indistinguishable from female of *P. schizophorus* except for the longer, more narrowly produced apex of the antennal postpedicel in most specimens (Fig. 7).

Geographical distribution and seasonal occurrence (Fig. 22). Known from the montane and coastal forests of western North America from British Columbia, Washington and Oregon, south to northern California. Adults have been collected from the end of May until the middle of August.



FIGURES 9–12. *Philetus* morphology. **9.** *P. memorandus*, wing. **10.** *P. memorandus*, female terminalia, dorsal view; from Sinclair & Cumming (2006, fig. 208). **11.** *P. memorandus*, male terminalia, lateral view. **12.** *P. schizophorus*, male terminalia, lateral view. Abbreviations: an lb—anal lobe; bm-m—basal medial crossvein; cerc—cercus; CuA—anterior branch of cubital vein; cua—anterior cubital cell; CuP—posterior branch of cubital vein; dm—discal medial cell; dm-m—discal medial crossvein; gen fk—genital fork; M₁, M₂, M₄—medial veins; R₁, R₂₊₃, R₄, R₅—radial veins; Sc—subcostal vein; spmth—spermatheca; tg—tergite.



FIGURES 13–16. *Philetus memorandus* male terminalia. **13.** Lateral view. **14.** Hypandrium and phallus, dorsal view. **15.** Hypandrium and phallus, lateral view. **16.** Epandrium and proctiger, dorsal view. Abbreviations: cerc—cercus; ej apod—ejaculatory apodeme; epand—epandrium; epand lb—epandrial lobe; goncx apod—gonocoxal apodeme; hypd—hypandrium; hypd rd—hypandrial rod; m ap hypd proc—median apical hypandrial process; m sbepand lb—medial subepandrial lobe; pgt—postgonite; ph—phallus; v sbepand lb—ventral subepandrial lobe.

Remarks. Female specimens collected from the same localities as males of *P. memorandus*, at or around the same seasonal date, were generally assumed to be conspecific with associated males. In addition, the identity of a number of female specimens of *P. memorandus* was confirmed by comparing COI mitochondrial DNA barcode sequences (with length = 657–658 bp) from males and females that clustered together with <2% genetic divergence (Fig. 24). Male and female specimens with shorter sequence lengths (264–342 bp) also clustered with *P. memorandus* (Table 1); two specimens (326 and 342 bp) clustered with <2% genetic divergence and seven specimens (264–307 bp) clustered with *P. memorandus* at approximately 4% genetic divergence. Female specimens with these shorter sequence lengths (Table 1) were additionally considered to be conspecific with *P.*

memorandus based on this barcode sequence data. Subsequent examination of these identified females in conjunction with males also revealed a subtle difference in the shape of the apex of the antennal postpedicel in most specimens of *P. memorandus* (Fig. 7), when compared with the postpedicel of most specimens of *P. schizophorus* (Fig. 8).

Philetus memorandus has been collected more often than *P. schizophorus*, but is still only taken infrequently. However, one large series of male and female specimens was collected in the canopy of a coastal wet temperate rainforest (Fig. 3) on Vancouver Island, British Columbia (see Marshall & Winchester 1999). The specimens were all collected in Malaise traps placed more than 30 metres above the forest floor (Fig. 2), but were not taken in traps placed at ground level. This may indicate that the rarity associated with *Philetus* could actually be due to adults being active high in the canopy of coastal and montane forests, rather than to low abundance levels.

***Philetus schizophorus* Melander**

(Figs 5, 6, 8, 12, 17–20, 23)

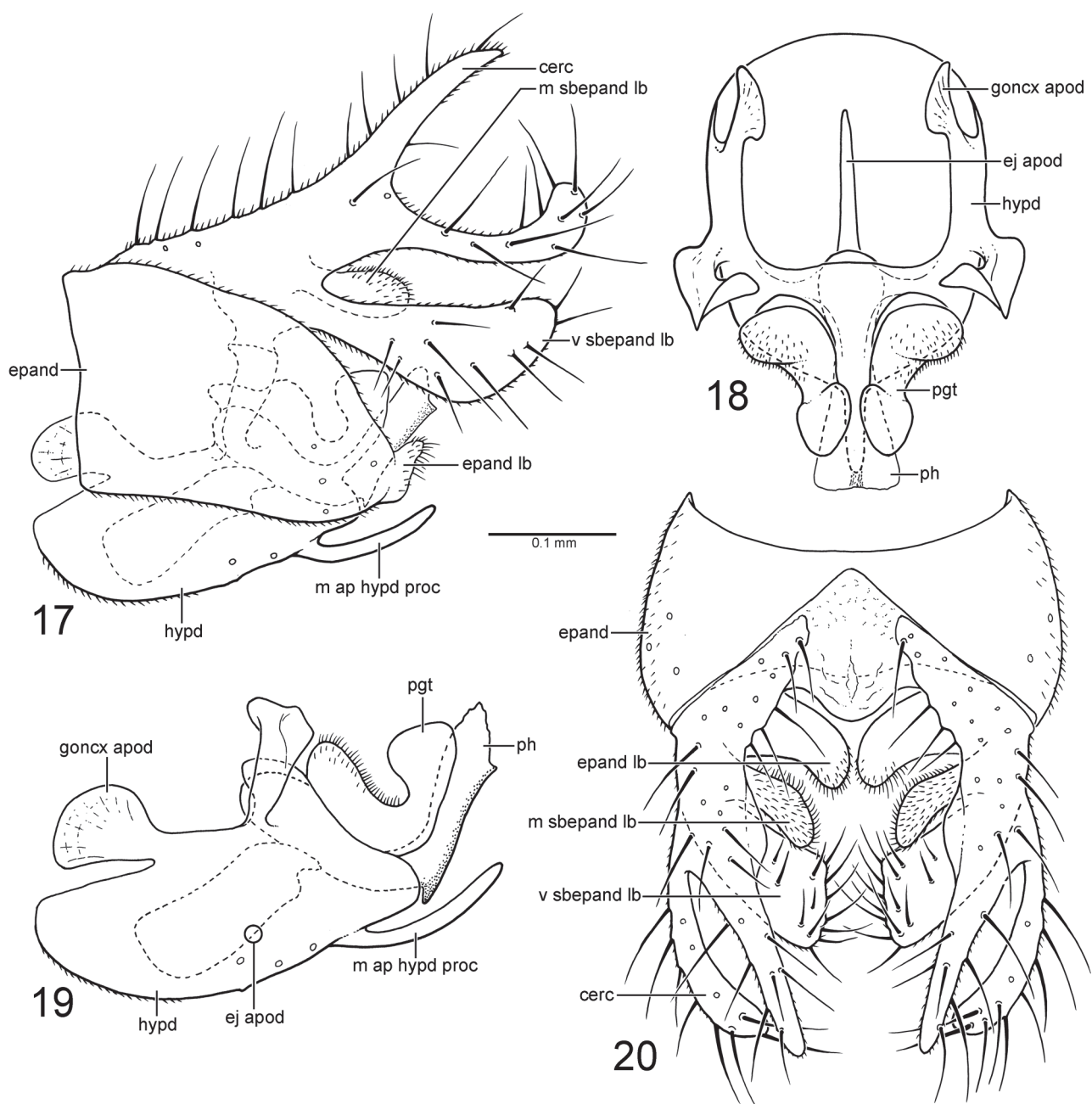
Philetus schizophorus Melander, 1928: 110. Melander, 1965: 455; Poole, 1996: 158, 563; Yang *et al.*, 2007: 350.

Type material examined. **LECTOTYPE** (here designated in order to fix identity of the species), ♂ labelled: “Mt.RainierWn/ VanTrump Crk [above Christine Falls]/ Sept. 1, 1917/ A.L.Melander”; “TYPE/ *Philetus schizophorus*/ Mel. [mostly hand-written red label]”; “ALMelander/ Collection/ 1961”; “LECTOTYPE/ *Philetus schizophorus* Melander/ des. Cumming, Brooks &/ Sinclair 2016 [red label]” [left hind leg glued to minuten mount] (USNM). **PARALECTOTYPE.** Same locality and date as lectotype [but indicated as paratype on mostly hand-written red label] (1♂, USNM). Our paralectotype label has additionally been attached to this specimen.

Additional material examined. **CANADA. British Columbia:** Glacier National Park, Illecillewaet trail from Cmpgrd, 20.vii.2012, 1320 m, 51°16.018'N 117°29.799'W, B.J. Sinclair (1♀, CNC); same data except, JSS #43836 (1♀ barcode-associated, CNC). **USA. Alaska:** Matanuska-Susitna Borough: Fern Mine [61°49'31"N 149°14'25"W], 27.vii.1956, WCF (1♂, WSU). **Arizona:** Apache County: White Mts., Coulter Ranch, 28.vi.1947, 9200 ft., John L. Sperry (1♂, USNM). **Colorado:** Lake County: Fremont Pass, Climax [ca. 39°18'5.26"N 106°15'44.46"W], 11318 ft., 19.viii.1983, P. Arnaud, Jr., at flr. *Achillea*, JSS #43837 (1♀, CAS); Larimer County: Pinewood Springs, MT in woods along sm. crk, 40.269476°N 105.360503°S, 7.ix.–12.x.2014, MT039, S. & B. Fitzgerald, JSS #43839 (1♂ barcoded, CNC). **Montana:** Flathead County: Glacier National Park: 1 mi. NW Logan Pass [ca. 51°16'N 117°29'W], 6500 ft., stream, 18.viii.1969, E.M. Fisher (1♀, CAS). **Nevada:** Elko County: 12 mi. S Wells, Angel Lake [ca. 41°1'35"N 115°5'7.42"W], 11.vii.1961, J.G. Chillcott (1♂, CNC). **Oregon:** Hood River County: Starvation Creek State Park, at falls [ca. 45°41'14"N 121°41'18"W], 26.vi.1978, D.D. Wilder (1♀, CAS). **Washington:** Pierce County: Mt. Rainier NP, West End Rd., 3 mi. N jct. Hwy 706 on Tahoma R., 2500 ft., 12.viii.1977, sweeping, W.J. Turner (1♂, WJTC); Yakima County: White Pass [46°38'19"N 121°23'22"W], Leech Lake, 4500 ft., 15.vii.1983, 1578/1/30–, J.A. Downes, CNC DIPTERA # 103881 (1♂, CNC). **Wyoming:** Yellowstone Park, Canyon Camp, 12.viii.1918 (1♀, USNM, see “Type material examined” under *P. memorandus*).

Diagnosis. *Philetus schizophorus* is characterized by male terminalia (Figs 12, 17–20) with elongate apically bifid male cercus connected to narrow rounded medial subepandrial lobe and long apically expanded ventral subepandrial lobe, small truncate epandrial lobe, hypandrium without apical rods, with thin short median apical hypandrial process, postgonite projected dorsally as broad U-shaped lobe, and dorsally directed phallus with unexpanded partially desclerotized apex. The shorter, more broadly produced apex of the antennal postpedicel (Fig. 8) in both sexes separates most specimens from those of *P. memorandus*.

Redescription. Male. Body length 3.0–4.0 mm, dark brownish grey, covered with silvery grey tomentum. Antenna dark brown to black; postpedicel pyriform with apex broadly produced towards stylus (Fig. 8). Legs brown to greyish brown. Wing hyaline with brownish veins. Halter brownish white. Terminalia (Figs 12, 17–20): hypandrium without apical rods arising above base of thin short median apical process; postgonite projected dorsally as broad U-shaped lobe, basal portion with minute setulae; phallus tubular, directed dorsally near mid-point adjacent pair of ventral medial teeth, apex partially desclerotized and not expanded; epandrial lobe small, truncate, with some minute setulae; ventral subepandrial lobe long, expanded apically along dorsal margin; medial subepandrial lobe narrow, apically rounded, connected basally to cercus, without short spine-like setulae along apical margin; cercus elongate, bifid apically with long pointed dorsal lobe and club-shaped ventral lobe.



FIGURES 17–20. *Philetus schizophorus* male terminalia. **17.** Lateral view. **18.** Hypandrium and phallus, dorsal view. **19.** Hypandrium and phallus, lateral view. **20.** Epandrium and proctiger, dorsal view. Abbreviations: cerc—cercus; ej apod—ejaculatory apodeme; epand—epandrium; epand lb—epandrial lobe; goncx apod—gonocoxal apodeme; hypd—hypandrium; m ap hypd proc—median apical hypandrial process; m sbepand lb—medial subepandrial lobe; pgd—postgonite; ph—phallus; v sbepand lb—ventral subepandrial lobe. Figures 17 and 20 are based on a specimen from Mt. Rainier, Washington; Figs 18 and 19 are based on a specimen from White Mts., Arizona.

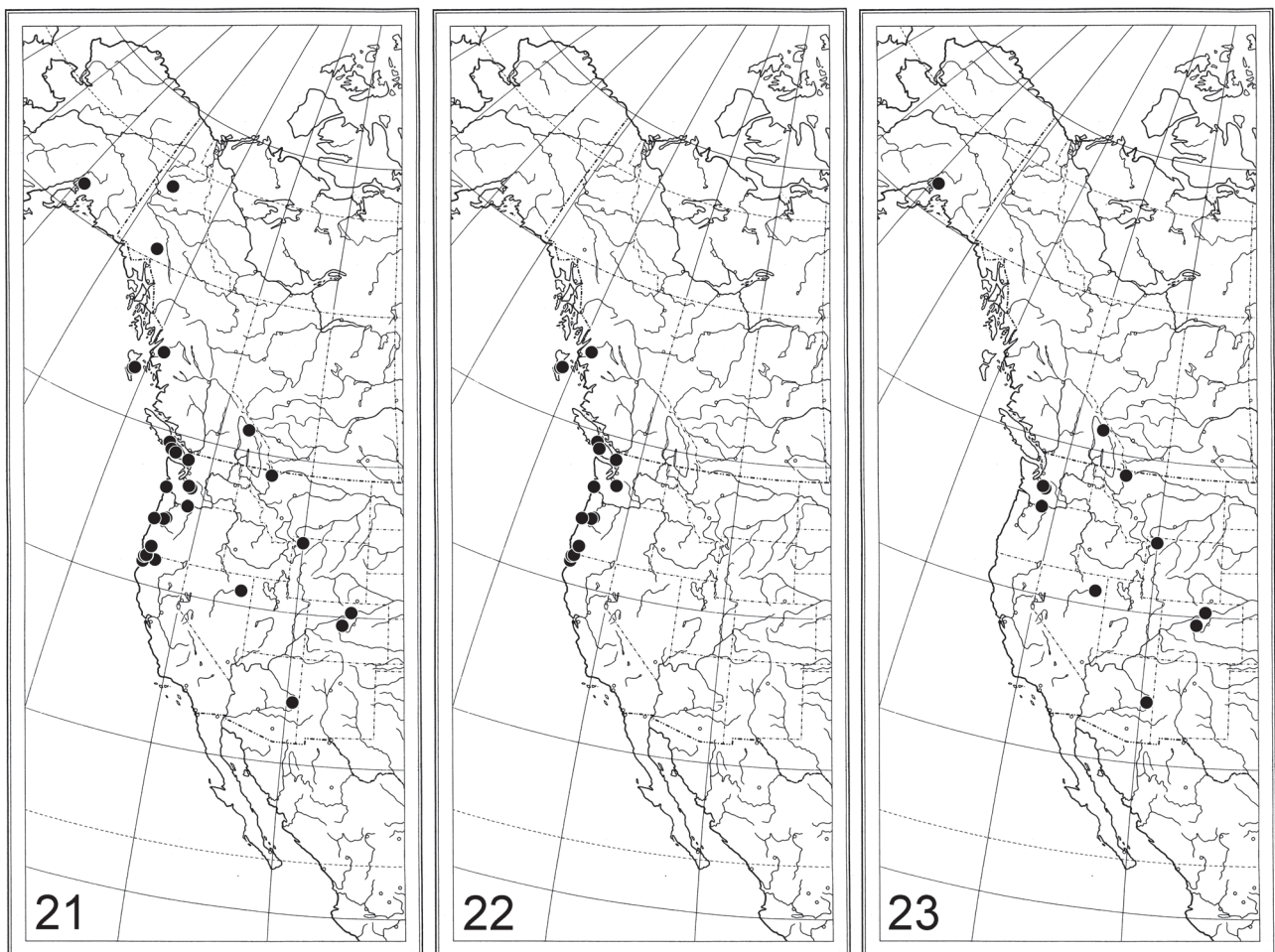
Female. Body length 3.5–4.0 mm. Similar to male except for female terminalia. Nearly indistinguishable from female of *P. memorandum* except for the shorter, more broadly produced apex of the antennal postpedicel in most specimens (Fig. 8).

Geographical distribution and seasonal occurrence (Fig. 23). Known from the montane and coastal forests of western North America from Alaska south to Arizona, including records from British Columbia, Washington, Oregon, Montana, Wyoming, Nevada and Colorado. Adults have been collected from late June until the middle of October.

Remarks. Two COI mitochondrial DNA barcode sequences (with length = 658 bp) were obtained from a

single male and female of *P. schizophorus* (Table 1), which clustered together with <2% genetic divergence (Fig. 24). This confirms the species identity of the female specimen, as well as a second associated female taken during the same collecting event (listed above under “Additional material examined”). *Philetus schizophorus* has rarely been collected and until now the female has remained unknown. Subsequent examination of these two identified females in conjunction with males, also revealed a very subtle difference in the shape of the apex of the antennal postpedicel in most specimens of both species (compare Figs 7 and 8), allowing for the recognition of additional specimens of *P. schizophorus*.

The distribution of *P. schizophorus* while overlapping with *P. memorandum* in Washington and Oregon, seems more widespread, extending northward to Alaska, and eastward into Nevada, Arizona, and along the Rocky Mountains of British Columbia, Montana, Wyoming, and Colorado. The seasonal records also appear to stretch into the fall compared with those of *P. memorandum* (i.e., until the middle of October rather than the middle of August).



FIGURES 21–23. Distribution of *Philetus*. 21. Overall distribution of the genus *Philetus*, including undetermined female specimens. 22. Known distribution of *P. memorandum*. 23. Known distribution of *P. schizophorus*.

Discussion

There has been some confusion regarding the homologies of the male genitalia in *Philetus*. Based on examination of *P. memorandum*, Sinclair & Cumming (2006) considered the dorsal structures to be lobes of the cercus, with the epandrium bearing an additional apical lobe. Subsequently in a paper analyzing the *Hesperempis* genus group, Cumming *et al.* (2014) used *P. memorandum* as one of the outgroup taxa in their matrix and coded the dorsal structures as cercus and dorsal surstylus respectively, and the apical epandrial lobe as the ventral surstylus. Our examination of the male terminalia of *P. schizophorus* (when compared with *P. memorandum*) now indicates that

the homologies of Sinclair & Cumming (2006) were essentially correct, with the dorsal lobes derived from the proctiger and the apical epandrial lobe not considered surstyler. The ventral subepandrial lobe and medial subepandrial lobe in *P. schizophorus* are more obviously attached to the cercus than they are in *P. memorandum*, confirming that they are both part of the proctiger in *Philetus*. Contrary to the interpretation in Sinclair & Cumming (2006, fig. 275) however, the postgonites in *P. memorandum* are now considered to include only the broad rounded lobes that flank the phallus and not also the slender sickle-shaped apical hypandrial rods that occur in that species (Fig. 14).

As has been indicated, Sinclair & Cumming (2006) classified *Philetus* as *incertae sedis* within their restricted concept of the Empididae. Their strict consensus tree more precisely showed *Philetus* to be the sister group to the *Hesperempis* genus group + (Hemerodromiinae + Empidinae), although without a great deal of support. In their analysis of the *Hesperempis* genus group, Cumming *et al.* (2014) suggested that *Philetus* might be more closely related to the Hemerodromiinae + Empidinae. The current interpretation of the male terminalia of *Philetus*, in possessing a clasping proctiger and lacking dorsal and ventral surstyli, further separates the genus from the *Hesperempis* genus group. Interestingly, this is somewhat similar to the situation in most members of the Hemerodromiinae + Empidinae lineage, which has been characterized by clasping male cerci and no surstyli (Sinclair & Cumming 2006).

Philetus appears to be another example of an old relict Eremoneuran group that is restricted to western North America. Additional relict Eremoneuran genera endemic to this region include: *Brochella* Melander and *Zanclotus* Wilder (Empididae); *Boreodromia* Coquillett, *Ceratempis* Melander, *Niphogenia* Melander and *Sabroskyella* Wilder (Brachystomatidae); *Melanderia* Aldrich (Dolichopodidae); as well as *Apystomyia* Melander (Apystomyiidae) (Melander 1928; Arnaud 1958; Wilder 1981, 1982; Nagatomi & Liu 1994; Sinclair 1999, 2008; Sinclair *et al.* 2013). *Philetus* will probably remain classified as a relatively isolated lineage within the Empididae until additional synapomorphies are found and more specimens are discovered. Molecular evidence, beyond that provided by COI mitochondrial DNA sequences, should also assist in resolving the phylogenetic relationships of the genus within the Empididae.

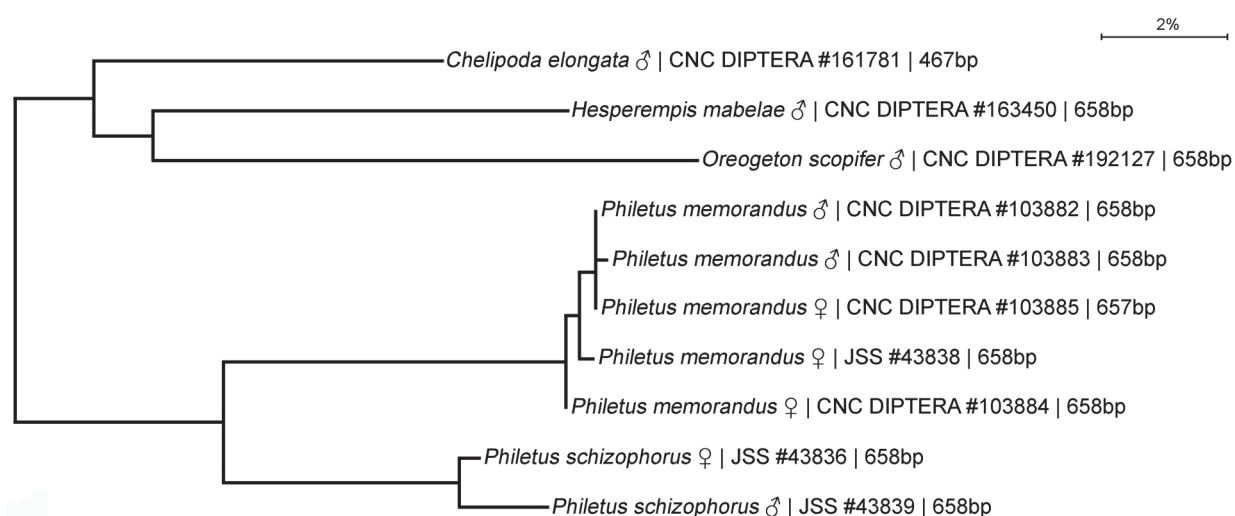


FIGURE 24. Neighbour-joining tree of seven *Philetus* specimens and three outgroup specimens with COI sequences of >450 base pairs (bp).

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to collect in Mt. Rainier National Park (Permit No. MORA-2012[2013]-SCI-0017) and California Parks and Recreation allowed JMC and SEB to collect in Redwood National and State Parks (Permit No. REDW-2008[2009]-SCI-0005). Stephen Marshall gave us permission to republish his habitus photograph of *Philetus* and Neville Winchester kindly supplied the pictures from the Upper Carmanah Valley.

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APPENDIX. Examined material of undetermined female specimens of *Philetus*.

CANADA. British Columbia: Vancouver Is., 1.7km from Lake Cowichan [ca. 48°49'32"N 124°3'16"W], 19–28.vii.1985, I.M. Smith, MT, CNC DIPTERA #103894 (1♀, CNC). **Yukon Territory:** km 141 Dempster Hwy, 23.vii.1982, pan trap, D.M. Wood (1♀, CNC); same data except, carrion, cliff, tundra, 1–13.vii.1987, S.A. Marshall (1♀, DEBU); Whitehorse [ca. 60°43'16"N 135°3'24"W], Hi-Country R.V. Park, 29.vii.1996, P.H. & M. Arnaud, Arnaud Flight Trap, Collection No. 01592 (1♀, USNM). **USA. California:** Siskiyou County: Fish Creek [near Scott Bar], 12.vi.2009, S.A. Marshall (1♀ photographed, DEBU). **Oregon:** Benton County: 5 mi. up Woods Crk Rd from jct. Hwy 20, mixed woods, 15–30.v.2014, ca. 44.544022, -123.503047, MT, S. Fitzgerald (1♀, CNC). **Washington:** Pierce County: Mt. Rainier, White River [ca. 46°54'N 121°38'W], 23.vii.1924, A.L. Melander (1♀, USNM).